
Mars Scout

CRITERIA AND GUIDELINES FOR THE CONCEPT STUDY REPORT

| February 14, 2008

CRITERIA AND GUIDELINES FOR THE PHASE A CONCEPT STUDY

INTRODUCTION

The Phase A Concept Study for each investigation will constitute the investigation's Concept and Technology Development Phase (Phase A) of the formulation subprocess as outlined in NPR 7120.5D, *NASA Space Flight Program and Project Management Requirements*. The requirements in Section 4.4.2 of NPR 7120.5D are waived per footnote 16 of that document except for the information required by these Concept Study Report (CSR) Guidelines. For the purposes of NPR 7120.5D, the Mars Scout mission is a Category 2 project. However, due to the NASA Authorization Act of 2005, which sets thresholds for Congressional reporting, some certifications and approvals will be at the Agency level. The purpose of a Phase A Concept Study is to better define the investigation, its implementation requirements, and its risks, as well as to describe the implementation plan for Education and Public Outreach (E/PO). The Phase A Concept Study period can also be used to mature the proposal concept presented in response to the AO by demonstrating proof of concept and/or conducting additional development testing to reduce/retire risks. In addition, it is expected that the proposer will use the Phase A Concept Study period to refine requirements and project interfaces with the Mars Exploration Program (MEP), the Jet Propulsion Laboratory (JPL) Deep Space Network (DSN) office and Multimission Ground Systems and Services (MGSS) office (if applicable), and other critical support functions. Signed Letters of Commitment from the DSN and MGSS critical support elements are mandatory to provide assurance that the project's requirements have been assessed and are supportable. Finally, and perhaps most importantly, the Phase A period should be utilized to finalize all cost estimates and develop the project funding profile necessary to implement the investigation with an acceptable level of risk - ***the project cost proposed at the completion of Phase A is the cost that a Mars Scout proposal team will be expected to meet for the entire life of the project.*** Any subsequent increase in this cost without the full endorsement of the MEP Director will be grounds for cancellation of the project.

Upon completion of their Phase A Concept Study, each proposer will submit a Concept Study Report (CSR) for NASA evaluation. The CSR is to be a self-contained document; that is, selected investigators should not assume that NASA evaluators will have reviewed or even have access to the original proposal. Please note that all program constraints, guidelines, definitions, and requirements given in the AO are still valid for the CSR except as noted herein. Likewise, specific guidelines and definitions for proposal preparation are still valid for the CSR except where specifically amended in this document (for example, page counts are amended herein to account for the added degree of expected maturity of the investigation's implementation).

Proposers should be aware that they are responsible for the content and quality of the entire CSR, including parts that may be prepared by any of their partners. All assumptions and calculations should be carefully documented in the CSR and reviewed by the Principal Investigator (PI) and his/her team to ensure that they are accurate and will satisfy the requirements of NASA and its supporting organizations.

The CSRs are due by 4:00 PM Eastern time, May 23, 2008, at the address below.

Mars Scout 2006 AO
Science Mission Directorate
NASA Research and Education Support Services
500 E Street SW, Suite 200
Washington DC 20024-2760
Tel: 202-479-9030

In addition to the CSR, the evaluation process will also include a site visit by the evaluation team to hear oral briefings by each of the investigation teams. For planning purposes, these oral briefings can be expected to last one full workday and will be conducted about 10 weeks after submittal of the CSR.

Each PI will also be invited to give an oral presentation on the scientific merit, scientific implementation merit, and feasibility of his/her proposal to the Selecting Official for the Science Mission Directorate (SMD) at NASA HQ. For planning purposes, this presentation can be expected to last half an hour and will be conducted about 12 weeks after the submittal of the CSR.

It is recognized that Mars Scout investigations are subject to three kinds of risks:

- inherent risks (including launch and space environments, mission durations, technology extensions, and unknowns);
- programmatic risks (those uncertainties imposed by the program such as Environmental Assessment approvals, budget uncertainties/changes, political impacts, and late/non-delivery of government-provided project elements);
- implementation risks (those elements under the control of the investigation team including such things as schedules, funding allocations, management structure, development approach, supporting organizations, and risk aversion/management approach including planning for known and unknown inherent and programmatic risks).

The primary purpose of the Phase A Concept Study is to develop detailed implementation plans for the proposed investigation so that the third kind of risk, implementation risk, can be judged. At the same time, however, any special features of the proposed investigation that add unusual resiliency against either inherent or programmatic risk should be described.

Part I of this document discusses the criteria to be used by NASA for the evaluation of the CSR. Part II provides guidance for preparation of the CSR. Guidelines for the project site visit will be provided in writing no later than four weeks prior to the site visit.

As a result of the evaluation of the Concept Study Reports, the Selecting Official for the SMD expects to confirm one Mars Scout mission investigation to proceed to a Risk-Reduction Phase. NASA will not continue funding for investigations that are not selected to proceed. All investigation teams will be offered a debriefing of all findings.

The MEP cost cap for Mars Scout 2006 has been adjusted upward from the original AO based on likely increases in launch vehicle costs. The adjusted cap for Scout 2006, in FY06\$, is now \$486M. The total proposed MEP cost in FY06\$ shall not exceed this cap. The funding for the extended Phase A (\$1M in FY08) and the Risk Reduction Phase (up to \$6M in FY09) is outside this cap.

The launch service costs of any NASA-provided ELV must be included in the proposal's MEP and Total Mission Cost. If the investigation is selected for flight, NASA expects to contract with the appropriate U.S. launch-service provider to acquire the launch service for the investigation, and fluctuation of the cost of the launch vehicle will not be the responsibility of the PI once the mission is selected. However, the PI is responsible for any increased costs resulting from mission-generated changes in launch vehicle or launch services requirements at any time in the development of the mission.

PART I - EVALUATION CRITERIA

The NASA evaluation process of the Phase A concept studies will be conducted in a manner similar to that used in the evaluation of proposals (see Section 8.0 of the AO). Since the selected investigations are those judged to have compelling science, it is expected that the science objectives will not change during the Phase A studies. If, however, there are changes to the science implementation that might affect these objectives, the science merit will be reevaluated. Assuming that there are no changes to the science objectives from those in the proposal, the Phase A evaluation will primarily evaluate all of the implementation planning for each investigation and consider in detail all factors related to the probability of mission success and to the realism of the proposed costs to NASA. This evaluation will also consider the investigation team's plans for E/PO.

Successful implementation of a Mars Scout investigation demands, in addition to scientific merit, that the investigation be achievable within the established constraints on cost and schedule. The information requested in Part II of this document will enable NASA to determine how well each mission team understands the complexity of its proposed investigation, its technical risks, and any weaknesses that require specific action during Risk-Reduction Phase and Phase B.

The criteria to be used for evaluation of the CSR are as follows:

- The scientific merit of the proposed investigation (will not be reevaluated unless it is determined that the science has changed from that described in the proposal or an issue was raised by the peer review) (25%)
- The scientific implementation merit and feasibility of the proposed investigation (25%)
- The feasibility of the proposed approach for mission implementation, including cost risk (i.e., realism and reasonableness of cost) (50%)

Additional selection factors are as follows:

- The MEP cost.
- The merit of plans for E/PO and Student Collaboration (SC) including implementation feasibility.
- The Science Enhancement Opportunity (SEO) or Technology Demonstration Opportunity (TDO) merit and implementation feasibility.

Scientific Merit of the Investigation.

It is expected that the science objectives will not change from those given in the proposal. The scientific merit of each investigation as established by the peer review of the proposal will be, however, reexamined to determine if significant changes have occurred as a result of details provided in the Phase A CSR with regards to the implementation details of the science investigation. If a reevaluation is judged to be necessary, the definitions and process for evaluating this criterion will be the same as those used for the

proposal review. Given no change in the science, the peer review panel rating from the proposal will remain valid for the CSR.

Scientific Implementation Merit and Feasibility of the Proposed Investigation

The information provided in response to Part II of this document will be used to evaluate each investigation in detail for its technical merit, scientific feasibility, resiliency, and probability of success. Although this criterion was evaluated during the proposal phase, it will be reevaluated during this Phase A Concept Study, which now will have science implementation details for evaluation. As a result, the evaluation of this AO criterion will be supplemented with the following considerations:

The scientific implementation of the investigation will be reevaluated from the data provided in the CSR and the site visit to look specifically at the level of implementation risk based on the feasibility of the investigation's technical approach, instrumentation provided to acquire the data, plans for science operations and data acquisition, plans for science descope, technical capabilities of the investigation team, and the plans for data analysis and archiving.

Feasibility of the Mission Implementation, Including Cost Risk

The information provided in response to Part II of this document will be used to evaluate each investigation in detail for the feasibility of mission implementation as reflected in the perceived risk of accomplishing the mission within proposed resources. The mission feasibility as a whole and as reflected in the subfactors (technical approach, management and organization, and cost) will be assessed, as well as each of these subfactors separately. This AO criterion will be supplemented with the following considerations:

The evaluation will consider the proposer's understanding of the processes, products, and activities required to accomplish development of all elements (e.g., mission design, launch systems, flight systems, communications systems, ground and data systems, etc.), the integration of all elements, and the adequacy of the proposed approach including reserves and margins. The mission operations approach will be evaluated to determine the adequacy of the plans and the resources for conducting the mission. The technical approach will be examined in its entirety to ensure that: (1) all elements and processes are addressed, (2) weaknesses and design issues are understood and plans for resolution have been identified, (3) fundamental design trades have been identified and studies planned, and (4) primary performance parameters have been identified and minimum thresholds established. The overall technical approach (including a well-defined schedule), the specific design concepts, and the known hardware/software will be evaluated for soundness, achievability, and maturity. Resiliency and design performance margins will be factors in this evaluation. The advantages (e.g., higher performance and/or lower costs) and disadvantages (e.g., higher technical risk) of any new technology will be evaluated in the context of the overall feasibility of the proposed investigation. Investigations dependent on new technology will not be penalized for risk provided that adequate plans are described to provide a reasonable backup approach that will assure the success of the investigation within the proposed resources.

The experience and expertise of the development organizations will be important factors in assessing the probability of success. Innovative, cost-effective features, processes, or approaches will be rewarded if proven sound. The information provided in the Management section should demonstrate the proposer's plans, processes, tools, and organization for managing and controlling the development and operation of the mission, including performance measurement and reporting. The soundness and completeness of the implementation approach as defined in a Work Breakdown Structure (WBS), and the probability that the investigation team can assure mission success will be evaluated by reviewing the organizational structure (including roles, responsibilities, accountability, and decision making process) and the processes, plans, and strategies the team will use to manage the various mission elements. Factors in this evaluation will include: clear lines of authority, clean interfaces, prudent scheduling and cost-control mechanisms, review processes, and demonstrated awareness of all necessary management processes. Additional factors in the evaluation of the probability of mission success will include the experience and past performance, expertise, and commitment of key personnel and the organizations to which they are attached, the adequacy of facilities and equipment proposed for the mission, the adequacy of the team's approach to risk management, and the adequacy of the management and control mechanism. Innovative management processes and plans will be rewarded if proven to be sound.

The completeness of the Risk-Reduction Phase and Phase B plans will also be considered in determining the adequacy of the overall implementation approach. This will include an evaluation of the activities/products, the organizations responsible for those activities/products, and the detailed schedule to accomplish the activities/products.

The credibility and realism of the proposed cost estimates and the planned financial resiliency will be evaluated. The underlying rationales for the cost estimates, including cost reserves, technical reserves and margins, and the development schedule, including schedule margins, will be factors in this evaluation.

The subcontracting plan will be evaluated on whether the proposer provides maximum practicable opportunities for small business participation and on the extent of participation of small disadvantaged business concerns. The effect of the subcontracting plan on the technical, management, or cost feasibility of the proposed investigation will also be evaluated. See Section 6.9 and Appendix A, Section XII of the AO for details concerning small and small disadvantaged business requirements

The evaluation results will be an assessment of mission implementation risk (High, Medium, or Low).

Additional selection factors include the MEP cost, the merit of the E/PO plan (including SC) and, if included, the merit and implementation feasibility of the SEOs and TDOs.

Quality of Plans for E/PO and Student Collaboration, Including Implementation Feasibility

All proposed investigations must submit an E/PO component as part of their CSR. The criteria to be used to evaluate the E/PO component and a discussion of those criteria is given in the document *Explanatory Guide to the NASA Science Mission Directorate*

Education and Public Outreach Evaluation Criteria (October 2006), which may be found in the Mars Scout Library. See Section 6.8 of the AO for further details on the E/PO requirements.

Science Enhancement Opportunity (SEO) and Technology Demonstration Opportunity (TDO)

SEOs and TDOs are optional and may be offered to NASA in addition to the Baseline Mission as part of the original proposal. If SEOs and/or TDOs were part of the original proposal **and** NASA selects them to be included in the Phase A Concept Study, then NASA will evaluate each SEO or TDO on its merit and feasibility.

The evaluation of the merit of the proposed SEO or TDO included an assessment of whether it provides an enhanced science return, an advance in NASA's technology base, uses innovative technology approaches to achieve the scientific goals, uses innovative technologies that may have continuing applicability to future SMD missions, or provides benefits to the Baseline Mission and/or future missions. It is expected that the SEO or TDO objectives will not change from those given in the proposal. The SEO or TDO merit as established by the peer review of the proposal will be, however, reexamined to determine if significant changes have occurred as a result of details provided in the Phase A CSR with regards to the implementation details of the SEO or TDO. If a reevaluation is judged to be necessary, the definitions and process for evaluating this criterion will be the same as those used for the proposal review. Given no change in the objectives, the peer review panel rating from the proposal will remain valid for the CSR.

An evaluation of the feasibility includes assessing whether the scope of the investigation is appropriate and follows the guidelines in Section 6.12.4 of the AO. The evaluation will also address whether the SEO or TDO is clearly separable from the Baseline mission to the extent that it will not impact the proposed Baseline Mission if the SEO or TDO development or operation has technical, schedule, or cost problems, and is deleted from the mission or fails in flight. A separate cost must be provided for each proposed SEO or TDO. The likelihood of completing the proposed development for the proposed cost will be assessed. The development plans, schedule and funding will be evaluated. The development schedule and risk management approach will be assessed to determine if the development is feasible. Discussion of the SEO or TDO must include appropriate review and decision points during development to assess whether further investment is warranted or whether the SEO or TDO is ready to proceed to the next milestone or flight.

PART II

REQUIRED QUANTITIES, MEDIA, FORMAT, AND CONTENT

The signed original of the CSR and fifty (50) paper copies are required. It is required that each paper copy of the CSR be accompanied by a CD containing an electronic PDF format version of the CSR in a single file. The PDF document must be searchable and bookmarks must be used to outline major sections of the document. In addition, the Master Equipment List (MEL) and cost and staffing data are required in Microsoft EXCEL format. A Microsoft Project version of the schedule is also to be provided. Each CD that will accompany the original or a copy of the CSR must include the required files. *These CDs and the files must be readable with both PC and Mac computers.* The required uniform format and contents are summarized below. Failure to follow this outline may result in reduced ratings during the evaluation process and could lead to the investigation not being confirmed for continuation.

Do not include any other information on the CD that is not included in the paper volumes of the CSR. Additional information on websites may not be referred to in any version of the CSR.

When changes from the original proposal have been made to the science investigation (including science implementation) as a result of the Concept Study, ***these changes from the proposal must be clearly identified.*** See Sections E and F for information on highlighting changes. Note that all program constraints, guidelines, requirements, and definitions given in the AO are still valid for the CSR except as noted herein.

The CSR page limits are shown on the next page. Other guidelines are as follows:

- Three-ring binders should be used.
- The CSR is limited to no more than seven foldout pages (28 x 43 cm; i.e., 11 x 17 inches) for the page-count limited sections.
- A foldout page counts as one page.
- All pages other than foldout pages shall be 8.5 x 11 inches
- Each side of paper on which text or figures appears, including foldouts, is counted as a page.
- Single- or double-column format is acceptable.
- In complying with the page limit, no page may contain more than 55 lines of text and the type font must not be smaller than 12 point except within figures and tables, where the type font must not be smaller than 10-point.

The following page limits apply:

Section	Page Limit
A. Cover Page and Investigation Summary	As needed
B. Table of Contents	2
C. Fact Sheet	2
D. Executive Summary	5
E. Science Investigation (changes highlighted)	30
F. Technical Approach G. Management Plan H. E/PO Plan I. Risk Reduction, Preliminary Design and Technology Completion (Risk-Reduction Phase and Phase B) Plans	103 *
J. Cost Information for Phase A through E: Cost Proposal for Risk Reduction Phase Cost Estimate for Phase B Cost Estimate for Phase C/D Cost Estimate for Phase E Cost Estimate for any SEO, TDO, or SC Cost Estimate for E/PO Cost Estimate for Total Mission	No page limit, but data must be presented in formats described; be brief
K. Appendices (no other appendices permitted) Letters of Commitment Subcontracting Plan Relevant Experience and Past Performance Resumes Statement(s) of Work for Each Contract Option Level 1 Requirements Radioactive Heating Units Plan (as applicable) Planetary Protection Approach Incentive Plan(s) Compliance with Procurement Requirements by NASA PI (if applicable) Technical Content of Any International Agreement(s) Discussion on Compliance with U.S. Export Laws and Regulations Communications Link Budget Design Data Cost and Pricing for Risk Reduction Phase Contract Additional Cost Data to Assist Validation Science Change Matrix Data Management Plan Approach Sample Curation Plan (if appropriate) Project Plan Approach Orbital Debris Analysis Reference List (optional) Abbreviations/Acronyms List Independent Technical Authority Heritage	No page limit, but small size encouraged

* Note: If NASA has selected a SEO, TDO, or SC for the CSR, then eight additional pages per SEO, TDO, or SC may be included.

A. COVER PAGE AND INVESTIGATION SUMMARY

The guidelines in the AO, Appendix B, apply except that the cover page will not be generated or submitted online.

B. TABLE OF CONTENTS

The CSR shall contain a table of contents that parallel the outline provided in Sections C through K below.

C. FACT SHEET

A Fact Sheet that provides a brief summary of the proposed investigation must be included. The information conveyed on the Fact Sheet should include the following: science objectives (including the importance of the science to the NASA science themes), mission overview (including mission objectives and major mission characteristics), science payload, key spacecraft characteristics, anticipated ELV, launch date, major elements of the E/PO program, mission management (including teaming arrangement as known), schedule, cost estimate, and any SC, SEO or TDO. Other relevant information, including figures or drawings, may be included at the proposer's discretion. The Fact Sheet is restricted to two pages (preferably a double-sided single sheet).

D. EXECUTIVE SUMMARY

The Executive Summary is to be a summary of the contents of the CSR and is to include an overview of the proposed baseline investigation including its scientific objectives, any SEO or TDO, the technical approach, management plan, cost estimate, and E/PO (including SC) plans. The Executive Summary should be no more than 5 pages in length.

E. SCIENCE INVESTIGATION

This section shall describe the science investigation resulting from the Phase A Concept Study. If there are no changes, the science investigation section must be repeated identically from the proposal with a statement that there are no changes. Any descoping of, or changes to, the investigation from the Baseline Mission and Performance Floor science defined in the proposal must be identified in this section. Changes should be highlighted in bold with column marking for easy identification. In addition, a change matrix giving the original (proposed) requirement, the new requirement, rationale for the change, and its location within the CSR is required as an appendix (see Section K.16).

F. TECHNICAL APPROACH

The Technical Approach section should detail the method and procedures for investigation definition, design, development, testing, integration, ground operations, and flight operations. Proposers must provide a sufficient level of detail to allow NASA to validate all aspects of the mission concept. Failure to provide sufficient detail could cause NASA to be unable to validate the concept, which could result in a High Risk rating. This section must discuss all new technologies planned for the investigation including backup plans with scheduled decision criteria if those technologies cannot be made ready. This section should also detail the expected products and end items (including hardware and software) associated with each mission phase. Mission teams have the freedom to use their own processes, procedures, and methods. The use of innovative processes, techniques, and activities by mission teams in accomplishing their objectives is encouraged when cost, schedule, technical improvements, and risk containment can be demonstrated. The benefits and risks, if any, of any such processes and products should be discussed. This section must be complete in itself without the need to request additional data, although duplications may be avoided by reference to other sections of the CSR if necessary. This section should address any proposed SEO or TDO.

1. Technical Approach Overview. This section should provide a brief overview of the technical approach including its key challenges.
2. Mission Design. This section should fully describe the operational phase of the mission from launch to end of mission. It should include information on the proposed launch date (including any launch date flexibility), launch location and vehicle, trajectories, delta-V requirements, orbit characteristics, encounter geometry (orbiter, flyby, lander, etc.) and characteristics (flyby speed, orbital period, etc.), mission duration, and a preliminary mission timeline indicating periods of data acquisition, data downlink, etc. It should also include detailed analyses of all phases of the trajectory/orbit design including total delta-V, times of trajectory correction maneuvers and delta-V's, and contingency studies and details for major events on the trajectory. The mission design should also describe DSN or other communications network to be used and interface requirements, along with potential impacts or conflicts with other users of the selected communications resources. Describe any design trade studies conducted or planned. Any trade studies involving ELVs must still require that NASA be the launch service provider.

The AO requires that “the UHF relay will be used to support missions launched in the 2013 launch opportunity or later”. The revised Scout launch date raises the possibility that the Scout mission may be called upon to provide contingency relay services during the Scout's primary science mission phase. The CSR should address the operational capability for the Scout to provide a total of up to 4 relay passes per sol to user spacecraft at Mars during the Scout primary mission phase. Typical relay passes could involve both forward (command) and return (telemetry) relay services; contact times of no more than 15 minutes per individual relay contact can be assumed for planning purposes, with forward link data volumes per pass of 4 Mb and

return link data volumes per pass of 250 Mb. Any potential impacts to primary phase science due to provision of contingency relay services should be discussed and quantified. The CSR should establish the readiness date after which contingency relay services would be possible, and should identify any time periods after this date and during the Scout primary science phase during which contingency relay services would be precluded for any reason.

A “traceability matrix” showing how the proposed mission design complies with the stated objectives, requirements, and constraints of the proposed investigation, including planetary protection compliance, should be included. The rationale for the selection of the ELV should be included. The Concept Study should identify any innovative features of the mission design that minimize total mission costs.

3. Technology. This section should discuss how any technology development relates to the proposed investigation, from which project(s) the technology comes, its current level of technology readiness, modifications necessary in order to use the technology for this investigation, and whether there are workarounds for the technology if plans for its usage on this investigation cannot be affirmed by the Preliminary Design Review (PDR)/Key Decision Point (KDP) C. The functions that the new technology performs and how it will be demonstrated for the investigation should be described. This section must describe the proposed plan – and backup plans, if any – for bringing each of the identified items to a minimum of TRL 6, defined as “system/subsystem model or prototype demonstration in a relevant environment, space, or ground”, by the KDP C at the end of Phase B. These plans may include discussion of simulations, prototyping, systems testing, life testing, etc., as appropriate.

For SEOs or TDOs, this section should discuss how the SEO/TDO provides an enhanced science return, advances NASA’s technology base, uses innovative technology approaches to achieve the scientific goals, uses innovative technologies that may have continuing applicability to future SMD missions, or provides benefits to the Baseline Mission and/or future missions. The section must also describe how the SEO or TDO it is clearly separable from the Baseline mission to the extent that it will not impact the proposed Baseline Mission if the SEO or TDO development or operation has technical, schedule, or cost problems, and is deleted from the mission or fails in flight. The technology development plan, development schedule, and risk management approach must be described in sufficient detail to determine the likelihood of completing the proposed SEO/TDO development on schedule and for the proposed cost. This section must describe all review and decision points during development that allow the proposer to assess whether further investment is warranted or whether the SEO/TDO is ready to proceed to the next milestone or flight.

4. Spacecraft. This section should describe the spacecraft design/development approach, particularly as it relates to new versus existing hardware and software and redundant versus single-string hardware. It should fully identify

the spacecraft systems and describe their characteristics and requirements. A description of the flight system design with a block diagram showing the flight subsystems and their interfaces should be included, along with a description of the flight software, and a summary of the estimated performance of the flight system. The flight heritage or rationale used to select the flight system and its subsystems, major assemblies and software elements, and interfaces should be described. The discussion of heritage should address two important issues: (1) prior flight experience or flight-qualified design of specific subsystem hardware and software components, and (2) overall subsystem design, whether new, modified, or exact repeat of a design flown previously. Assumptions about potential cost savings that result from heritage must be quantified and explained in the Cost Proposal section (Section J) below. This section should also discuss the design *process* used: trade studies, simulations, technology development, engineering models, prototypes, etc. Any discussion of heritage must include the current state of development or operations of the heritage mission, system, or component and must describe any modifications or developments required to apply the heritage design to the proposed mission.

Subsystem characteristics, requirements, and expected performance should be described to the greatest extent possible for the following subsystems: structural/mechanical, solar array/power supply (and batteries), electrical, thermal control, propulsion, communications, attitude control, command, software, and data handling. Such characteristics include current best estimate and contingency for: mass, volume, and power requirements; CPU, buffer, memory, databus utilization and timing; performance; pointing knowledge and accuracy; and expected degradation/losses. It should also include new developments needed; the space qualification plan; and logistics support. Include block diagrams with sufficient detail to allow NASA to determine the adequacy of the proposed subsystem.

Any design features incorporated to effect cost savings should be identified; however, benefits should be specified and enabling assumptions or risks should be identified. A summary of the resource elements of the flight systems design concept, including key margins, should be provided. The rationale for, and derivation of, margin allocations including mass, power, communication link performance (data and carrier), pointing accuracy, etc., should be provided. Those design margins that are driving costs should be identified. Provide data in tables to show the current estimate of data storage margin and computer processor utilization margin. The MEL should summarize component-level information for all hardware subsystems of the spacecraft and any other hardware elements (e.g., probes, canisters, and individual instruments). The unit quantity, current best estimate mass, estimated contingency mass percentage and value, and the current best estimate plus contingency mass value should be provided for each component. Component-level mass estimates should be presented individually and summed at the subsystem and system level. Heritage, design status, level of modification planned, and new development should also be described for each component.

Show how the characteristics of and requirements on the spacecraft are traceable to the objectives, requirements, and constraints of the investigation.

5. Science Implementation. This section should describe the science implementation for the investigation, including the data acquisition and processing system. Highlight any changes to the payload or individual instruments or their performance since submission of the proposal and provide a summary in the Science Change Matrix (see Section K.16). Information pertinent to the accommodation of the instrumentation on the spacecraft should also be included. Subsystem characteristics and requirements should be described. Such characteristics include: mass, volume, and power requirements; computing and data resource requirements; pointing requirements; new developments needed; and a space qualification plan. Include where appropriate: block diagrams, layouts, calibration plans, operational and control considerations, and software functions. Any design features incorporated to effect cost savings should be identified. A summary of the resource elements of the instrument design concept, including key margins, should be provided. The rationale for margin allocation should be provided. Those design margins that are driving costs should be identified. The MEL should summarize component-level information for each instrument, including payload common elements.

Special attention should be given to assuring that both the planning and resources are adequate to analyze, interpret, and archive all the data produced by the investigation in the appropriate data archive (Planetary Data System or other, as justified). Include a discussion of the software system that will be used, the amount of new development, the team structure and staffing concept and location(s), and interfaces for the instrument processing system(s). The approach for science algorithm development (if appropriate) and the integration of the algorithms into the processing system should also be discussed. Resources include cost, schedule, and work-hours for scientific interpretation of results and publication.

Show how the characteristics and requirements of the science implementation are traceable to the objectives, requirements, and constraints of the investigation.

The draft Level-1 science requirements of the investigation, as agreed to by the PI, PM, and other key personnel, must be clearly identified in this section.

6. Payload Integration. This section should characterize the interface between the instruments and the flight system. These include, but are not limited to: volumetric envelope, fields of view, weight, power requirements, thermal requirements, command and telemetry requirements, sensitivity to or generation of contamination (e.g., electromagnetic interference, gaseous effluents, etc.), data processing and storage requirements, as well as the planned process for physically and analytically integrating them with the

flight system. The testing strategy of the science payload, prior to integration with the spacecraft, should be discussed.

7. Manufacturing, Integration, and Test. This section should describe the manufacturing strategy to produce, test, and verify the hardware/software necessary to accomplish the mission. It should include a description of the main processes/procedures planned in the fabrication of flight hardware and development of mission-critical software, production personnel resources, incorporation of new technology/materials, and the preliminary test and verification program. The environmental tests planned should be discussed and proposed test margins and durations for the environmental test program specified. Part burn-in requirements that will be used for the program should also be defined. Describe the approach for transitioning from design to manufacturing and specify data products which will be used to assure producibility and adequate tooling availability.

The approach, techniques, facilities, and ground support equipment (GSE) planned for integration, test and verification, and launch operations phases (including launch integration and processing), consistent with the proposed schedule and cost, should be described. A preliminary schedule and flow diagram for manufacturing, integration, and test activities – including system-level performance tests with the flight software – should be included. A description of the planned end items, including engineering and qualification hardware and software, should be included.

8. Mission Operations, Ground, and Data Systems. This section should discuss the overall Operations Plan including a block diagram of all ground and flight components, show all interfaces between Science Operations Centers (SOCs) and the Mission Operations Center (MOC) and describe what functions are performed at the SOC and MOC and the data systems necessary to support those functions. Describe the mission operations and the ground operations support required for the proposed investigation. The planned approach for managing mission operations and all flight operations support, including mission planning and scheduling, command sequence generation, uplink commanding, trajectory tracking, navigation, and telemetry downlink and analysis should be discussed. Describe the approach for emergency communications during any phase of the mission. Describe all inter-facility communications, computer security, and near real-time ground support requirements, licenses and/or approvals required. Indicate any special equipment or skills required of ground personnel. Provide a staffing plan for both mission operations and science payload operations. Proposers planning to utilize the DSN and/or the MGSS are required to contact those offices during the Concept Study to better understand the options and associated costs for NASA-provided operations and communications services.

The approach to the development of the Ground Data System (GDS), including design heritage and the use, if any, of existing facilities including Government facilities, should be described. All usage of the DSN and of any

existing non-DSN facilities should be explicitly described (see *NASA's Mission Operations and Communications Services* document in the Mars Scout Library for specific requirements and contacts) including plans for pre-launch compatibility testing. Any mission-unique facilities must be adequately described. Include a block diagram of the GDS showing the end-to-end concept (acquisition through archiving in the appropriate data archive) for operations and data flow to the subsystem level. Describe all communications, tracking, and ground support requirements; flight-ground trade studies; and integration and test plans. Describe the space/ground link spectrum requirements and the licensing approach. Proposers should contact an appropriate NASA Frequency Spectrum Management organization to ascertain licensing and frequency assignment requirements. An appropriate Spectrum Management organization is typically located in the organization providing Earth station or Tracking and Data Relay Satellite System (TDRSS) support. Describe the software and its relationship to the flight system software.

Specific features incorporated into the flight and ground system design that lead to low-cost operation should be identified. The use of any existing mission operations facilities and processes should be described, as well as any new facilities required to meet mission objectives.

9. Facilities. Provide a description of any new, or modifications to existing, facilities, laboratory equipment, and GSE (including those of the team's proposed contractors and those of NASA and other U.S. Government agencies) required to execute the investigation. The outline of new facilities and equipment should also indicate the lead time involved and the planned schedule for construction, modification, and/or acquisition of the facilities.
10. Software Development Approach. Provide a Master Software List summarizing all major ground and flight software elements, characterizing function (including fault protection), estimated size, inheritance/heritage, operational platform, and responsible team member for developing each element. Describe the investigation team's plan for acquiring, inheriting or developing, testing, validating and verifying flight and ground software over all mission phases. Provide assumptions on inheritance and describe the cost basis for the software. Provide a description of the test environment for the flight software, including the fidelity and availability of the proposed simulators used for testing. In summary, this section should describe the overall software design and test approach whereas the requirements and functionality of flight and ground software should be described in Sections F.4, F.5, F.7, and F.8.
11. Product Assurance, Mission Assurance and Safety. This section should describe the process by which the product quality is assured to meet the proposer's specifications, including identification of trade studies and the parts selection strategy. This section should also describe the product assurance plan, including plans for problem/failure reporting, inspections, quality control, parts selection and control, reliability, safety assurance, and

software validation. Describe the risk mitigation efforts that address designing for meeting lifetime requirements, dormant reliability (reliability after long periods of in which the unit has not powered or used), and cold environment and radiation effects. Describe the radio science link and any ultrastable oscillator requirements and how the project plans to meet these requirements. In addition, investigators should be aware of mission assurance topics of recent Agency-level special emphasis for all NASA missions. Such topics include Red Team Reviews, subsystem-level Failure Mode Effects Analysis, Probabilistic Risk Assessment with its subset of analysis tools, Continuous Risk Management, and Software Independent Verification and Validation (IV&V).

G. MANAGEMENT PLAN

This section sets forth the investigator's approach for managing the work, the recognition of essential management functions, and the overall integration of these functions. This section should specifically discuss the decision-making process to be used by the team, focusing particularly on the roles of the PI and the PM in that process. The PI is responsible for fulfilling or delegating the role assigned to the PM in Table 3-1 of NPR 7120.5D. Include a discussion of the relationship among the investigation team, the MEP Program Office (MPO) at JPL, and NASA Headquarters. (See the "MEP Program Plan" in the Mars Scout Library.) The management plan should give insight into the organizations proposed for the work, including the internal operations and lines of authority with delegations, external interfaces and relationships with NASA, major subcontractors and partners, and associated investigators. It also should identify the institutional commitment of all team members (including team members responsible for E/PO) and the institutional roles and responsibilities. For institutions that are not NASA centers, the senior authorizing official for the institution is responsible for fulfilling or delegating the role assigned to the Center Director in Chapter 3 of NPR 7120.5D. This role includes assigning a senior systems engineer that is funded by that institution's engineering organization who reports technical issues to the Program Chief Engineer. This role also includes assigning a Safety and Mission Assurance (SMA) lead that is funded by that institution's SMA organization who reports SMA issues to the Program SMA lead. The use of innovative processes, techniques, and activities by mission teams in accomplishing their objectives is encouraged; however, they should be employed only when cost, schedule, or technical improvements can be demonstrated and specific enabling assumptions are identified.

1. Team Member Responsibilities. This section should describe the roles, responsibilities, time commitment, and experience of all team member organizations and key personnel, with particular emphasis placed on the responsibilities assigned to the PI, PM, Deputy PM, Project Systems Engineer, and other key personnel. In addition, information should be provided which indicates what percentage of time key personnel will devote to the mission, the duration of service, and how changes in personnel will be accomplished. (Note: The experience of the PI and science team members does not need to be included in this section since that has been addressed in the science investigation section.)

- a. Organizational Structure. The management organizational structure of the investigation team must be described in the CSR. This section must include an organizational chart that addresses the relationships and reporting structures of the organizations through the key positions (see Section G.1.b). Each key position, including its roles and responsibilities, how each key position fits into the organization, and the basic qualifications required for each position, must be described. In addition, this section must include a WBS to at least level 3. Referring to the WBS, the CSR must describe the responsibilities of each team member organization and its contributions to the investigation. A discussion of the unique or proprietary capabilities that each member organization brings to the team, along with a description of the availability of personnel at each partner organization to meet staffing needs should be included. The contractual and financial relationships between team partners should be discussed.

Summarize the subcontracting plan and its effect on the technical, management, and cost feasibility of the investigation and refer to supporting detail in the subcontracting plan which is provided in Section K.2.

Summarize the relevant institutional experience in this section, and refer to supporting detail included in Section K.3, Relevant Experience and Past Performance. If experience for a partner is not equivalent to, or better than, the requirements for the proposed mission, explain how confidence can be gained that the mission requirements will be accomplished within cost and schedule constraints.

- b. Experience and Commitment of Key Personnel. Provide a history of experience explaining the relationship of the previous experience to each key individual's role on the proposed investigation; include the complexity of the work and the results. Refer to the resumes only for details on specific positions held and references. For each key person listed in this section, include in the resume a reference point of contact, including address, e-mail address, and phone number.
 - i. Principal Investigator. The role(s), responsibilities, and time commitment of the PI should be discussed.
 - ii. Project Manager, Deputy Project Manager, and Project Systems Engineer. The roles, responsibilities, time commitment, and experience of the PM, Deputy PM, and Project Systems Engineer should be discussed.
 - iii. Other Key Personnel. The roles, responsibilities, time commitments, and experience of other key personnel in the investigation including Co-Investigators (Co-Is) should be described.

2. Management Processes and Plans. This section should describe the management processes and plans necessary for the logical and timely pursuit of the work (including E/PO), accompanied by a description of the work plan. This section should also describe the proposed methods of hardware and software acquisition. The management processes which the investigation team proposes, including the relationship between organizations and key personnel, should be discussed, including the following, as applicable: systems engineering and integration; requirements development; configuration management; schedule management; team member coordination and communication; progress reporting, both internal and to NASA; performance measurement; and resource management. This discussion should include all phases of the mission including preliminary analysis, technical definition, the design and development, and operations phases, along with the expected products and results from each phase. Describe the systems engineering approach that will be used in the definition, flowdown, tracking, and verification of design requirements, resource allocation and control, interface requirements and configuration and software configuration control. Unique tools, processes, or methods, which will be used by the investigation team, should be clearly identified and their benefits discussed. All project elements should be covered to assure a clear understanding of project-wide implementation.
3. NEPA Compliance and Approval. If a radioisotope heater unit (RHU) is proposed, then two separate, yet related, processes of NEPA Compliance and Launch Approval shall be discussed. The requirement to utilize a RHU shall be incorporated in this discussion. A clear understanding of each process shall be presented, including the necessary documents to be prepared, reviews to be conducted, timing of the key process milestones, and identification of responsible agencies and organizations. Any project-unique risks posed by the investigation's implementation approach must be identified. A proposed schedule, including all key milestones, shall be presented. Any exceptions to traditional NEPA/Launch Approval milestone scheduling required to match the schedules to the investigation's implementation constraints shall be noted.
4. Schedules. A detailed project schedule with the critical path(s) clearly delineated is required. The schedule and workflow for the complete mission life cycle must be clearly defined, and the method and tools to be used for internal review, control, and direction discussed. Schedules for all major activities, interdependencies between major items, deliveries of end items, critical paths, schedule margins, and long-lead procurement needs (defined as hardware and software procurements required before the start of Phase C/D) should be clearly identified and discussed. Any essential technology developments and SEO/TDO development and decision points as well as major Engineering Test Units should be included. Provide a level 2 software build and delivery schedule that clearly indicates the relationship of the deliveries to the system integration and test activities from the start of test bed level testing all the way through final spacecraft level tests prior to launch. This should be accompanied by a listing of the functions contained in each build. Schedules are to be provided in MS Project format.

5. Risk Management. This section should describe the approach to, and plans for, risk management to be taken by the team, both in the overall mission design and in the individual systems and subsystems. Plans for using standard risk management tools for both hardware and software, especially fault tree analysis, probabilistic risk assessments, and failure modes and effects analyses, should be described. The role of the Project Systems Engineer in risk management should be discussed. Particular emphasis should be placed on describing how the various elements of risk, including new technologies used, will be managed to ensure successful accomplishment of the mission within cost and schedule constraints. Risk management for SCs, SEOs or TDOs must also be addressed. Investigations dependent on new technology will be penalized for risk if adequate plans to ensure success of the investigation are not described. At least the top three risks and their mitigation plans should be discussed. Any identified risks that will benefit from early risk-reduction efforts should be addressed in Section I., Risk-Reduction Preliminary Design, and Technology completion (Risk-Reduction Phase and Phase B) Plan.

A summary of reserves in cost and schedule should be identified by Phase and project element and year and the rationale for them discussed. The specific means by which integrated costs, schedule, and technical performance will be tracked and managed should be defined. Specific reserves and the timing of their application should be described. Management of the reserves and margins, including who in the management organization manages the reserves and when and how the reserves are released, should be discussed. This should include the strategy for maintaining reserves as a function of cost to completion. All funded schedule margins should be identified. The relationship between the use of such reserves, margins, potential descope options, and their effect on cost, schedule, and performance should be fully discussed. When considering potential descope options, consider the investigation as a total system including instrument(s), spacecraft, ground system, launch services, and operations.

The uncertainties in the baseline cost estimate must be discussed. A confidence level and high and low cost values around the proposed baseline cost estimate appropriate to the level of uncertainty must be discussed. A discussion justifying the confidence level and the high and low values must be provided.

6. Government Furnished Property, Services, Facilities, etc. This section should clearly delineate all Government-furnished property, services, facilities, etc. required to accomplish all phases of the mission. This includes items described more fully in other sections (e.g., DSN).
7. Reviews. This section should list the major project reviews expected to be conducted during the project's life cycle and the approximate time frame of each. The objective of each review should be indicated. See 7120.5D for the complete list of required reviews and the role of the Standing Review Board.

It should be noted that regular reviews of the progress of the E/PO component of the missions should be held in the same way that progress on the scientific and technical aspects are reviewed.

8. Reporting. This section should clearly describe the approach to reporting progress to the Government and indicate the progress reviews the Government should attend to provide independent oversight. The process, including the individual or organization responsible for reporting integrated cost, schedule, and technical performance should be discussed. Planned project status reporting should include inputs to the monthly and quarterly presentations to the governing Program Management Council (PMC), monthly and quarterly status reporting to the MPO, and, after the Project CDR, a brief weekly summary of progress via a web-based NASA SMD reporting site.
9. Software Independent Verification and Validation (IV&V). This section should describe the plan to comply with NPR 7120.5D and NPD 2820.1C for software IV&V. Discussion of the plan to task the NASA IV&V Facility in Fairmont, West Virginia to manage the conduct of IV&V for appropriate project-produced flight and ground software is required. The NASA IV&V Facility uses an on-line self assessment process, available at <http://ivvcriteria.ivv.nasa.gov/>, as a discussion starting point to understand risk and specific software development characteristics for the mission. Projects must negotiate the use of the NASA IV&V Facility but don't pay for it. The NASA IV&V Facility is to be considered as a provider of extra IV&V not a replacement for the project IV&V.

H. EDUCATION/PUBLIC OUTREACH PLAN

The education and public outreach should provide a summary of the benefits offered by the mission beyond the scientific benefits brought by obtaining and analyzing the desired scientific data.

1. Education and Public Outreach Activities. This section should build upon and extend the discussion of E/PO activities given in the proposal. As noted earlier in these Guidelines, it is expected that the Concept Study plans will be substantially refined and expanded beyond the level of detail contained in the original proposal. Plans for product development and dissemination, contributions to the training of underserved and/or underutilized groups in science and technology, arrangements with partners, schedules and budgets for activities, etc., are to be defined in sufficient detail that they can be evaluated at an appropriate level of depth. Where appropriate, references should be made to the Management Plan and other relevant sections for information on how the work is to be arranged, directed, implemented, reviewed, and reported. Letters of Commitment from partners/subcontractors and resumes from key E/PO personnel should be included as appendices to the CSR.

Note that investigations are required to coordinate their E/PO activities with, and to complement, the overarching "Mars Public Engagement Plan". Proposers are

encouraged to take advantage of infrastructure investments made by the Mars Exploration Program Public Engagement Office in ongoing educational and public outreach activities for greater reach and cost savings. Details on such ongoing programs can be found in "Opportunities to Leverage Mars Public Engagement Plan" in the Mars Scout Library.

2. Student Collaboration (Optional). The Concept Study may include a Student Collaboration (SC) if the SC was part of the original proposal **and** NASA selected it. A SC may involve development of an instrument, investigation of scientific questions, analysis and display of data, development of supporting hardware or software, and/or other aspects of the mission. The activities may involve flight, suborbital, or ground systems. A Concept Study that includes a Student Collaboration must fully describe the SC educational impact in the context of workforce development, as well as technical, maturity, processes, and mission risks. It must provide detailed plans for implementing the SC activities, including identification of and formal commitment from partner institutions, development schedule of the SC, decision points for determining SC readiness. An SC should aim to add value to the science or engineering of the mission, but the study must describe how the SC will be planned so that the baseline science investigation is not compromised in the event that the SC component is not funded, encounters technical, schedule, or cost problems, or fails in flight. The team shall provide an adequate plan for mentoring and oversight of students to maximize the opportunity for teaching, learning, and success in contributing to the mission. The SC is a part of the Education and Public Outreach effort and must be clearly identified as an E/PO element. The SC may have a separate 8 pages allocated to it to discuss its approach and implementation. The criteria to be used to evaluate the E/PO component and a discussion of those criteria is given in the document Explanatory Guide to the NASA Science Mission Directorate Education and Public Outreach Evaluation Criteria (October 2006) which may be found in the Mars Scout Library. The SC and the balance of the E/PO effort are evaluated independently and both must completely address the E/PO Evaluation Criteria. Although the cost of the SC must be included under the cost cap, the cost of the SC must be identified separately from the proposed investigation.

Questions and/or comments and suggestions about the MEP E/PO program are welcome; they may be directed to Larry Cooper (telephone: 202-358-1531; E-mail: larry.p.cooper@nasa.gov).

I. RISK REDUCTION PHASE AND PRELIMINARY DESIGN AND TECHNOLOGY COMPLETION (PHASE B) PLANS

This section should contain separate plans for the both Risk-Reduction Phase and the Preliminary Design and Technology Completion Phase (Phase B) of the project. The first part of this section should address plans for and products of a focused, one-year risk-reduction effort prior to the start of Phase B in FY10. In particular, it should identify specific risk items, including new technologies, which will be investigated in this period. The section should include objectives and the decision criteria to be used in evaluating the outcome of all studies and activities to be performed. Describe in detail the methods and

procedures for analysis, technology development, testing, and concept validation proposed to mitigate or retire the identified risks. Discuss the approach for further refining of the descope options presented in the Management Plan section of this CSR.

The Risk-Reduction Phase Plan should include a detailed schedule and define the products to be delivered and the schedule for their delivery. The schedule must include a delta-Mission Concept Review to assess progress made during the Risk-Reduction Phase, a System Requirements Review, and the following four product deliveries: a) a report on progress and status of risk items addressed, b) a complete set of Preliminary Level 1 requirements including mission success criteria, c) a Draft Descope Plan, and d) a Preliminary Project Plan including the Control Plans listed in the Phase A column of Table 4-4 of NPR 7120.5D. The review and deliverables are due at the end of the Risk-Reduction Phase, prior to Key Decision Point B (KDP B) and the beginning of Phase B.

The second portion of this section should address plans and products for the Preliminary Design and Technology Completion Phase (Phase B). It should identify the key mission tradeoffs to be performed and options to be investigated during Phase B including those issues, technologies, and decision points critical to mission success. This section should also describe and provide the rationale for any anticipated long-lead acquisitions.

The Phase B Plan should include a detailed schedule and define the products to be delivered and the schedule for their delivery. The schedule must include the Preliminary Design Review and the following product deliveries: a) a detailed Descope Plan including the criteria, impact and savings of descope options, b) a complete set of Baseline Level 1 requirements including mission success criteria, and c) a Baseline Project Plan including the Control Plans listed in the Phase B column of Table 4-4 of NPR 7120.5D.

J. COST PLAN FOR MISSION PHASES A THROUGH E

Immediately following down selection, NASA will implement funding for the first three months of the Risk-Reduction Phase, herein designated as the “Bridge Phase”, per the Bridge Phase SOW and cost proposal submitted in the CSR. During these three months, a contract for the remainder of the Risk-Reduction Phase and Phases B, C/D, and E will be negotiated based upon the cost proposals for the Risk-Reduction Phase submitted with the CSR and the detailed cost information submitted with the CSR for the subsequent mission phases (B/C/D/E). The contractor will be requested to submit a formal cost proposal based upon the Federal Acquisition Regulation (FAR) Part 15. The instruction and format for submission of this proposal are found in FAR Part 1 .403-5 and Table 15.2. It is essential that the cost elements proposed in the formal contract proposed to contract award be traceable to the cost proposal provided in the CSR. Any changes in cost from the Concept Study Report should be described in detail. The definitized contract will include an option provision for Phase B, C/D and E with a not-to-exceed amount for each phase. If the downselected investigation is managed by a NASA Center, the funding mechanics will be somewhat different than what is described in this paragraph; however, the same principles will apply.

The CSR cost proposal should provide information on the anticipated costs for all appropriate mission phases for the preferred baseline launch date. A detailed cost proposal is required for each of the following Phases: the Bridge Phase, Remainder of Risk-Reduction Phase, and Phase B. Cost estimates are also required for the follow-on phases (C/D, and E), including a description of the estimating techniques used to develop the cost estimates. Specific information that would better enable NASA to validate costs (e.g., WBS level 3 data) may be provided as an appendix (see Section K.15). A discussion of the basis of estimate should be provided with a discussion of heritage and commonality with other programs. Quantify and explain any cost savings that result from heritage. All costs, including all contributions made to the investigation, should be included.

Full-cost accounting for NASA facilities and personnel proposed must be submitted as directed in Section 6.10.2 of the AO. For the purpose of calculating the full cost of NASA provided services, the Center Management and Operations (CM&O) burden should be applied only to NASA provided services including on-site contractors; this cost must be included in the MEP cost of the proposal. The CM&O burden on off-site contracts (pass-through dollars) should not be included in the MEP cost of the proposal.

Proposers should complete a summary of total mission cost by fiscal year as shown in Figure 1, Total Mission Cost Funding Profile. The purpose of this summary is to (1) provide detailed insight into project costs by cost element and (2) provide a basis for comparison of the project proposed cost with the evaluation team's independent cost analysis. It presents all costs for the project *on one page*, by project phase (Phases A through E), by participating organization, and by fiscal year. Figure 1 may be expanded as necessary. A separate line must be inserted in NASA Center proposals for CM&O. If obligation authority in excess of identified costs is required, the proposal must also indicate the authority needed by year.

In addition, for each phase of the investigation (A, Risk Reduction, B, C/D, and E) a Time-Phased Cost Breakdown for each WBS element, as shown in Figure 2, should be completed. Use only the line items shown in Figure 2 that are relevant for each phase of the project. The purpose of this set of Figures is to provide detailed insight into how the project allocates funding during each phase of work.

The cost of the entire project should be summarized on one page and presented in the format shown in Figure 3. The purpose of Figure 3 is to provide detailed insight into project costs by cost element. Identify each reserve amount to the lowest level consistent with the proposed reserve management strategy. For example, if each subsystem manager will have spending authority over the reserves for the subsystem, each such amount should be identified separately. If more convenient, the reserve details may be shown in a separate table, with totals reported as shown in Figure 3. Show costs for all development elements by recurring and non-recurring components in the format of Figure 4. Show costs (NASA SMD and contributed) associated with each Co-I in the format of Figure 5.

Proposers should include all contributions provided by NASA Centers, including civil servant staff and the cost for the use of Government facilities and equipment, on a full-cost accounting basis. All direct and indirect costs associated with the work performed at NASA Centers should be fully costed and accounted for in the proposal and summarized using the template provided in Figure 6. The purpose of this data is twofold: 1) to determine those costs that are included in the NASA SMD cost but are not funded out of the Mars Scout program and 2) to determine civil-service contributions that are not included in the NASA SMD cost. Teams should work with their respective NASA Centers to develop estimates for these costs.

Note that the definitions for cost element terms shown in the cost figures are provided in the *Cost Element Definitions* document in the Mars Scout Library.

For FY07–FY09 proposers shall budget the following amounts in real-year (RY) dollars: \$2M in FY07, \$1M in FY08, and up to \$6M in FY09. The total MEP cost for FY07 and FY10 and beyond shall not exceed \$486M FY06. To convert the proposed RY costs to FY06\$ as required in the cost tables, proposers shall use the following inflation rates whenever there are no DCAA-approved forward-pricing agreements.

NASA Inflation Rates (March, 2007)

	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15
Inflation Rates	3.2%	2.8%	2.7%	2.7%	2.9%	3.0%	2.8%	2.7%	2.7%

All costs shall include all burdens and profit/fee in real-year dollars by fiscal year.

1. Cost Proposals for Risk-Reduction Phase. This section provides detailed cost proposals for performing the Risk-Reduction Bridge Phase and the remaining Risk-Reduction Phase. Detailed plans for the study should be described, but reference may be made to the Technical Approach and Management sections of the proposal, as appropriate.
 - a. Contract Pricing Proposal. Cost or pricing data is required for the Risk-Reduction Phase. Complete cost or pricing data must be included with the CSR proposal for each organization participating in the Risk Reduction Phase and must be signed by each organization's authorized representative. This requirement may be satisfied with one form provided that all institutions involved in the Risk-Reduction Phase are included with the appropriate signatures. The contract pricing proposal for the Risk-Reduction Phase may be provided as an appendix (see Section K.14).
 - b. Work Breakdown Structure. A WBS should be included for the Risk-Reduction Phase. The structure of the WBS should be consistent with the plans set forth in the Technical Approach and Management sections of the proposal and the Statement of Work provided as an Appendix to the proposal.

- c. Workforce Staffing Plan. Provide a workforce-staffing plan that is consistent with the WBS. This workforce-staffing plan should include all team member organizations and should cover all management, technical (scientific and engineering), and support staff. The workforce-staffing plan should be phased by month. Time commitments for the PI, PM, Deputy PM, and other key personnel should be clearly shown.
- d. Proposal Pricing Technique. Describe the process and techniques used to develop the Risk-Reduction Phase cost proposal. Provide a description of the cost-estimating model(s) and techniques used in the Risk-Reduction Phase cost estimate. Discuss the heritage of the models and/or techniques applied to this estimate, including any known differences between missions contained in the model's data base and key attributes of the proposed mission. Include the assumptions used as the basis for the Risk-Reduction Phase cost and identify those which are critical to cost sensitivity in the investigation. Identify any "discounts" assumed in the cost estimates for business practice initiatives or streamlined technical approaches. Describe how these have been incorporated in the cost estimate and will be managed by the investigation team.
- e. Risk Reduction Time-Phased Cost Summary. Provide a summary of the total Risk-Reduction Phase costs consistent with Figure 2. Risk Reduction Phase costs also appear in Figure 3, and in Figure 4 if development work is planned during Risk Reduction. The Risk-Reduction Phase cost summary should be developed consistent with the WBS and should include all costs to NASA along with all contributed costs. The Risk-Reduction Phase time-phased cost summary should be phased by month.
- f. Cost Elements Breakdown. To effectively evaluate the Risk-Reduction Phase cost proposals, NASA requires costs and supporting evidence stating the basis for the estimated costs. The proposal will include, but is not limited to:
 - i. Direct Labor.
 - (1) Explain the basis of labor-hour estimates for each of the labor classifications.
 - (2) State the number of productive work-hours per month.
 - (3) Provide a schedule of the direct labor rates used in the proposal. Discuss the basis for developing the proposed direct labor rates for the team member organizations involved; the forward-pricing method (including midpoint, escalation factors, anticipated impact of future union contracts, etc.); and elements included in the rates, such as overtime, shift differential, incentives, allowances, etc.
 - (4) If available, submit evidence of Government approval of direct labor rates for proposal purposes for each labor classification for the proposed performance period.
 - (5) If civil servant labor is to be used in support of the Risk-Reduction Phase, but is not to be charged directly to the investigation, then this labor must be considered as a

contribution by a domestic partner, subject to the same restrictions as other contributions by domestic or foreign partners. A discussion of the source of funding for the civil servant contributions must be provided.

- ii. Direct Material. Submit a summary of material and parts costs for each element of the WBS.
 - iii. Subcontracts. Identify fully each effort (task, item, etc. by WBS element) to be subcontracted, and list the selected or potential subcontractors, locations, amount budgeted/proposed and types of contracts. Explain the adjustments, if any, and the indirect rates (or burdens) applied to the subcontractors' proposed amounts anticipated. Describe fully the cost analysis or price analysis and the negotiations conducted regarding the proposed subcontracts.
 - iv. Other Direct Costs.
 - (1) Travel, Relocation, and Related Costs. Provide a summary of the travel and relocation costs including the number of trips, duration, and purpose of the trips.
 - (2) Computer. Provide a summary of all unique computer-related costs.
 - (3) Consultants. Indicate the specific task area or problem requiring consultant services. Identify the proposed consultants, and state the quoted daily rate, the estimated number of days and associated costs (such as travel), if any. State whether the consultant has been compensated at the quoted rate for similar services performed in connection with Government contracts.
 - (4) Other. Explain and support any other direct costs included in the Phase B proposal in a manner similar to that described above.
 - v. Indirect Costs.
 - (1) List all indirect expense rates for the team member organizations. Indirect expense rates (in the context of this AO) include labor overhead, material overhead, General and Administrative (G&A) expenses, and any other cost proposed as an allocation to the proposed direct costs.
 - (2) If the proposal includes support services for which off-site burden rates are used, provide a schedule of the off-site burden rates. Include a copy of the company policy regarding off-site vs. on-site effort.
 - (3) If available, submit evidence of Government approval of any/all projected indirect rates for the proposed period of performance. Indicate the status of rate negotiations with the cognizant Government agency, and provide a comparative listing of approved bidding rates and negotiated actual rates for the past five (5) fiscal years.
 - (4) Discuss the fee arrangements for the major team partners.
2. Cost Estimate for Phase B. This section provides a detailed cost estimate for performing the Phase B study. Detailed plans for the study should be described, but reference may be made to the Technical Approach and

Management sections of the proposal, as appropriate. In completing this section, the following guidelines will apply:

- a. Work Breakdown Structure. A WBS should be included for Phase B. The structure of the WBS should be consistent with the plans set forth in the Technical Approach and Management sections of the proposal and the Statement of Work provided as an Appendix to the proposal.
- b. Workforce Staffing Plan. Provide a workforce-staffing plan that is consistent with the WBS. This workforce-staffing plan should include all team member organizations and should cover all management, technical (scientific and engineering), and support staff. The workforce-staffing plan should be phased by month. Time commitments for the PI, PM, Deputy PM, and other key personnel should be clearly shown.
- c. Cost Estimating Techniques. Describe the process and techniques used to develop the Phase B cost estimate. Provide a description of the cost-estimating model(s) and techniques used in the Phase B cost estimate. Discuss the heritage of the models and/or techniques applied to this estimate, including any known differences between missions contained in the model's data base and key attributes of the proposed mission. Include the assumptions used as the basis for the Phase B cost and identify those which are critical to cost sensitivity in the investigation. Identify any "discounts" assumed in the cost estimates for business practice initiatives or streamlined technical approaches. Describe how these have been incorporated in the cost estimate and will be managed by the investigation team.
- d. Phase B Time-Phased Cost Summary. Provide a summary of the total Phase B costs consistent with Figure 2. Phase B costs also appear in Figure 3, and in Figure 4 if development work is planned during Phase B. The Phase B cost summary should be developed consistent with the WBS and should include all costs to NASA along with all contributed costs. The Phase B time-phased cost summary should be phased by month.
- e. Cost Elements Breakdown. To effectively evaluate the Phase B cost proposals, NASA requires costs and supporting evidence stating the basis for the estimated costs. The proposal will include, but is not limited to:
 - i. Direct Labor
 - (1) Explain the basis of labor-hour estimates for each of the labor classifications.
 - (2) State the number of productive work-hours per month.
 - (3) Provide a schedule of the direct labor rates used in the proposal. Discuss the basis for developing the proposed direct labor rates for the team member organizations involved; the forward-pricing method (including midpoint, escalation factors, anticipated impact of future union contracts, etc.); and elements included in the rates, such as overtime, shift differential, incentives, allowances, etc.

- (4) If available, submit evidence of Government approval of direct labor rates for proposal purposes for each labor classification for the proposed performance period.
 - (5) If civil servant labor is to be used in support of the Phase B study, but is not to be charged directly to the investigation, then this labor must be considered as a contribution by a domestic partner, subject to the same restrictions as other contributions by domestic or foreign partners. A discussion of the source of funding for the civil servant contributions must be provided.
- ii. Direct Material. Submit a summary of material and parts costs for each element of the WBS.
- iii. Subcontracts. Identify fully each effort (task, item, etc. by WBS element) to be subcontracted, and list the selected or potential subcontractors, locations, amount budgeted/proposed and types of contracts. Explain the adjustments, if any, and the indirect rates (or burdens) applied to the subcontractors' proposed amounts anticipated. Describe fully the cost analysis or price analysis and the negotiations conducted regarding the proposed subcontracts.
- iv. Other Direct Costs.
 - (1) Travel, Relocation, and Related Costs. Provide a summary of the travel and relocation costs including the number of trips, duration, and purpose of the trips.
 - (2) Computer. Provide a summary of all unique computer-related costs.
 - (3) Consultants. Indicate the specific task area or problem requiring consultant services. Identify the proposed consultants, and state the quoted daily rate, the estimated number of days and associated costs (such as travel), if any. State whether the consultant has been compensated at the quoted rate for similar services performed in connection with Government contracts.
 - (4) Other. Explain and support any other direct costs included in the Phase B proposal in a manner similar to that described above.
- v. Indirect Costs.
 - (1) List all indirect expense rates for the team member organizations. Indirect expense rates (in the context of this AO) include labor overhead, material overhead, General and Administrative (G&A) expenses, and any other cost proposed as an allocation to the proposed direct costs.
 - (2) If the proposal includes support services for which off-site burden rates are used, provide a schedule of the off-site burden rates. Include a copy of the company policy regarding off-site vs. on-site effort.
 - (3) If available, submit evidence of Government approval of any/all projected indirect rates for the proposed period of performance. Indicate the status of rate negotiations with the cognizant Government agency, and provide a comparative

listing of approved bidding rates and negotiated actual rates for the past five (5) fiscal years.

- (4) Discuss the fee arrangements for the major team partners.
3. Cost Estimate for Phase C/D. This section provides a cost estimate for performing the Final Design and Fabrication/System Assembly, Integration and Test, and Launch (Phase C/D) portion of the mission. The Phase C/D cost estimates should correlate with the plans set forth in the Science, Technical Approach, and Management sections of the proposal. In completing this section, the following guidelines will apply:
 - a. Work Breakdown Structure. A WBS should be included for Phase C/D. The WBS shall be described to the subsystem level (i.e., Attitude Control System, Propulsion System, Structure and Mechanisms, etc.) for the spacecraft and to the instrument level for the payload. All other elements of the WBS should be to the major task level (Project Management, Systems Engineering, Ground Support Equipment, E/PO, etc.).
 - b. Cost Estimating Techniques. Describe the process and techniques used to develop the Phase C/D cost estimate. Provide a description of the cost-estimating model(s) and techniques used in the Phase C/D cost estimate. Discuss the heritage of the models applied to this estimate including any known differences between missions contained in the model's data base and key attributes of the proposed mission. Include the assumptions used as the basis for the Phase C/D cost and identify those that are critical to the cost sensitivity in the investigation. Identify any "discounts" assumed in the cost estimates for business practice initiatives or streamlined technical approaches and the basis for these discounts. Describe how these have been incorporated in the cost estimate and will be managed by the investigation team.
 - c. Workforce Staffing Plan. Provide a workforce-staffing plan (including civil service) which is consistent with WBS. This workforce-staffing plan should include all team member organizations and should cover all management, manufacturing, technical (scientific and engineering), E/PO, and support staff. The workforce-staffing plan should be phased by fiscal year. Time commitments for the PI, PM, and other key personnel should be clearly shown.
 - d. Phase C/D Time-Phased Cost Summary. Provide a summary of the total Phase C/D costs consistent with Figure 2. The Phase C/D cost summary should be developed consistent with the WBS and should include all costs to NASA, along with all contributed costs. The Phase C/D time-phased cost summary should be phased by fiscal year. Also report Phase C/D costs in Figures 3 and 4. Phase C/D extends 30 days beyond launch so be sure to account for all costs for this period, including tracking support and mission operations.

4. Cost Estimate for Phase E. This section provides a cost estimate for performing Operations and Sustainment (Phase E) including E/PO. In completing this section, the guidelines for Phase C/D apply. Proposers may refer to the information provided in *NASA's Mission Operations and Communications Services* document in the Mars Scout Library for mission operations and communications costs, if NASA systems are proposed. Since the best possible cost estimates are desired, the contacts listed in the subject document should be consulted to assure accuracy as well as credibility.

5. Cost Estimate for any SEO, TDO, or SC. Provide a cost estimate for any SEO, TDO, or SC and reserves in this section. Such costs are included within the cost cap.

6. Cost Estimate for E/PO. This section should summarize the estimated costs to be incurred in Risk Reduction through Phase E of the investigation for the E/PO component. Provide detailed E/PO cost information in the format of E/PO Template 1, 2, and 3. Summary E/PO cost information must be provided in Figures 1-6 and be consistent with the E/PO Template information and the activities, products, programs, partnership arrangements, etc., defined in Section H.

7. Cost Estimate for Total Mission. This section should summarize the estimated costs to be incurred in Phases A through E including: Concept and Technology Development (Phase A), Risk Reduction; Preliminary Design and Technology Completion (Phase B); Final Design and Fabrication/System Assembly, Integration and Test (Phase C/D); Operations and Sustainment (Phase E); ELV, upper stages, and launch services; DSN and other ground system costs; and cost of activities associated for social or educational benefits (if not incorporated in any of Phases A through E). Figure 1 should be used to summarize these costs. The total mission cost estimate should be developed consistent with the WBS. Detailed plans for any aspects of the mission not discussed elsewhere in the CSR should be discussed here. The funding profile should be optimized for the mission. Contributions not included in the NASA MEP cost should be clearly identified as separate line items.

Figure 1																
TOTAL MISSION COST FUNDING PROFILE																
FY Costs in Real Year Dollars (to nearest thousand), Totals in RY and Fixed Year '06 Dollars																
	Formulation								Implementation				LIFE CYCLE			
	Phase A (CSR plus Ext Phase A)		Risk Reduction Bridge Phase	Remainder Risk Reduction Phase	Phase B		Subtotal Formulation		Phases C/D/E		Subtotal Implementation					
	FY07	FY08	FY09	FY09	FY10	...	FYz	RY \$	FY06\$	FY1	...	FYz	RY \$	FY06\$	RY \$	FY06\$
Cost Element **	Enter each cost element															
Start to Launch + 30 Days (Phase A/Risk Reduction Bridge Phase/Risk Reduction Phase/B/C/D)																
Phase A	2000	1000														
Risk Reduction																
Project Management/Mission Analysis/Systems Engineering																
Instrument A																
Instrument B																
Instrument ...																
Instr. Integration, Assembly and Test																
Subtotal - Instruments																
Spacecraft bus																
S/C Integration, Assembly and Test																
Other Hardware Elements ¹																
Launch Ops (Launch + 30 days)																
Subtotal - Spacecraft																
Science Team Support																
Pre-Launch GDS/MOS Development																
DSN/Tracking																
Other ²																
Subtotal Phases A-D before Reserves																
Instrument Reserves																
Spacecraft Reserves																
Other Reserves																
Total Phases RR/B/C/D																
Launch + 30 Days to End of Mission (Phase E)	Enter each cost element															
Mission Operations & Data Analysis (including Project Management)																
DSN/Tracking																
Other ²																
Subtotal Phase E before Reserves																
Reserves																
Total Phase E																
SEO/TDO/SC (optional)																
Reserves																
Total SEO/TDO/SC																
Launch Services																
Total MEP Cost Phase A-E																
Contributions ²																
Total Contributions																
Total Mission Cost =																
Total Capped Cost (= Total MEP Cost - (Extended Phase A and Total Risk Reduction))																

* Note: Implementation = Phase C + D + E
 ** See Cost Elements document in the Mars Program Library
¹ Other Hardware Elements: Probes, Sample Return Canister, Etc.
² Specify each item on a separate line; include Education and Public Outreach, facilities, etc.

Figure 2

TIME PHASED COST BREAKDOWN BY WBS AND MAJOR COST CATEGORY					
(Phased Costs in Real Year Dollars, Totals in Real Year and FY 2006 Dollars)					
WBS/Cost Category Description	FY1	FY2	...	Total (RY\$)	Total (FY 2006\$)
Total Direct Labor Cost	\$	\$	\$	\$	\$
WBS 1.0 Management					
WBS 2.0 Spacecraft					
WBS 2.1 Structures & Mechanisms					
WBS 2.2 Propulsion					
etc.					
Total Subcontract Costs	\$	\$	\$	\$	\$
WBS # and Description					
:					
etc.					
Total Materials & Equipment Cost	\$	\$	\$	\$	\$
WBS # and Description					
:					
etc.					
Total Reserves	\$	\$	\$	\$	\$
WBS # and Description					
:					
etc.					
Total Other Costs	\$	\$	\$	\$	\$
WBS # and Description					
:					
etc.					
Fee					
E/PO, Other (Specify)					
Total Contract Cost	\$	\$	\$	\$	\$
Total Other Costs to NASA MEP	\$	\$	\$	\$	\$
Launch Services					
Ground Segment					
E/PO, SEO/TDO, Other (Specify)					
Total Contributions (Non-U.S. or U.S.)	\$	\$	\$	\$	\$
Organization A:					
WBS # and Description					
etc.					
Organization B:					
WBS # and Description					
etc.					
Total Cost for Phase	\$	\$	\$	\$	\$

**Figure 3 Fiscal Year Costs in Fiscal Year 2006 Dollars (to nearest thousand)
(Totals in Real Year and Fiscal Year 2006 Dollars)**

Cost Element	FY1	FY2	FY3	...	FYn	Total (FY2006\$)	Total (RY\$)
Phase A							
Reserves							
Total Phase A							
Bridge Phase							
Remainder of Risk-Reduction Phase							
Phase B							
Reserves							
Total Phase B							
Phase C/D							
Instrument A							
Instrument B							
Instr Integ, Assy & Test							
<i>Subtotal – Instruments</i>							
Spacecraft Bus							
Spacecraft Integ, Assy & Test							
Other Hardware Elements							
Launch Ops							
<i>Subtotal – Spacecraft</i>							
Proj Mgmt/Miss Analysis/Sys Eng							
Science Team Support							
Prelaunch GDS/MOS Development							
E/PO, Other*							
<i>Subtotal Phase C/D before Reserves</i>							
Instrument Reserves							
Spacecraft Reserves							
Other Reserves							
Total Phase C/D							
Phase E							
MO&DA							
Tracking Services (Earth Station or TDRSS)							
E/PO, Other*							
<i>Subtotal Phase E before Reserves</i>							
Reserves							
Total Phase E							
Launch Services							
Total NASA MEP Cost	\$	\$	\$	\$	\$	\$	\$
Contributions*							
Total Contributions	\$	\$	\$	\$	\$	\$	\$
						Total Mission Cost	\$

*Specify each item on a separate line; include Education & Public Outreach, facilities, SEO, TDO, SC etc.

Figure 4

**PHASE C/D DEVELOPMENT COSTS
(Real Year Dollars to Nearest Thousand)**

Cost Element	Non-Recurring	Recurring	Total (RYS)	Total (FY 2006\$)
Instrument A *				
Instrument B*				
Instrument n *				
<i>Subtotal - Instruments</i>				
Structure and Mechanisms				
Attitude Control				
Power				
Subsystem n				
<i>Subtotal - Spacecraft Bus</i>				
Any other elements (specify)*				
<i>Subtotal - Other elements</i>				
Total NASA MEP Development Cost				

*Other elements: probes, sample return canister, etc. Specify each instrument by subsystem/components where possible.

Figure 5

	Risk- Reduction Phase	Phase B	Phase C/D	Phase E	Total (Real Year)	Total (FY 2006)
<i>NASA MEP Cost</i>						
Co-I #1 Name/Organization						
Percent Time						
Cost						
Co-I #2 Name/Organization						
Percent Time						
Cost						
Co-I #n Name/Organization						
Percent Time						
Cost						
Total NASA MEP Co-I Cost						
<i>Contributions</i>						
Co-I #1 Name/Organization						
Percent Time						
Cost						
Co-I #2 Name/Organization						
Percent Time						
Cost						
Co-I #n Name/Organization						
Percent Time						
Cost						
Total Contributed Co-I Cost						

**CO-INVESTIGATOR COMMITMENT AND COST
FUNDING PROFILE TEMPLATE**

(FY costs in Real Year Dollars, Totals in Real Year and FY2006 Dollars)

Figure 6

NASA CIVIL SERVICE COST FUNDING PROFILE TEMPLATE

(FY Costs in Real Year Dollars, Totals in Real Year and FY 2006 Dollars)

Item	FY1	FY2	FY3	FY4	FY5	FYn	...	Total (Real Yr.)	Total (FY 2006)
Workforce	\$	\$	\$	\$	\$	\$	\$	\$	\$
- NASA Center A									
- NASA Center B									
- etc.									
Facilities	\$	\$	\$	\$	\$	\$	\$	\$	\$
- NASA Center A									
E/PO, Other*	\$	\$	\$	\$	\$	\$	\$	\$	\$
- NASA Center A									
NASA Civil Service Costs included in NASA MEP Cost	\$	\$	\$	\$	\$	\$	\$	\$	\$
Contributions by NASA Centers									
Workforce	\$	\$	\$	\$	\$	\$	\$	\$	\$
- NASA Center A									
- NASA Center B	\$	\$	\$	\$	\$	\$	\$	\$	\$
- etc.	\$	\$	\$	\$	\$	\$	\$	\$	\$
Facilities									
- NASA Center A									
E/PO, Other*									
- NASA Center A									
Contributed NASA Civil Service costs	\$	\$	\$	\$	\$	\$	\$	\$	\$
Mission Totals								\$	

*Specify each item on a separate line.

E/PO Template #1
E/PO Program Budget
(FY costs in Real Year Dollars, Totals in Real Year and FY 2006 Dollars)

	FY1	FY2	FY3	FYn	Total (Real Yr.)	Total (FY 2006)
Personnel						
Subcontract #1						
Subcontract #2						
Subcontract #n						
Consultants						
Equipment						
Supplies						
Travel						
Other Direct Costs						
Facilities						
Administration						
Other Indirects						
Subtotal						
Cost Sharing						
TOTAL						

INSTRUCTIONS FOR E/PO BUDGET SUMMARY – TEMPLATE #1

Provide, as attachments, detailed computations of all estimates in each cost category with narratives as required to fully explain each proposed cost as follows.

1. Personnel: Attachments must list the number and titles of personnel, amounts of time to be devoted to the project, and rates of pay including salaries, wages, and fringe benefits.
2. Subcontracts/Partners/Co-I Institutions: Attachments must describe the work to be subcontracted, estimated amount, recipient (if known), and the reason for subcontracting. Enter the annual totals on this budget summary page. In addition, complete a more detailed budget summary form describing the subcontractor's/partner's/Co-I institution's use of NASA funds that the proposer requested through this solicitation (see Template #2 format).
3. Consultants: Identify consultants to be used, why they are necessary, the time (number of days) they will spend on the project, and quoted daily rates of pay. State whether the consultant has been compensated at the quoted rate for similar services performed in connection with Government contracts.
4. Equipment: List separately. Explain the need for items costing more than \$5,000. Describe basis for estimated cost. General purpose equipment is not allowable as a direct cost unless specifically approved by the NASA Contracting Officer. Any equipment purchase requested to be made as a direct charge under this award must include the equipment description, how it will be used in the conduct of the work proposed and why it cannot be purchased with indirect funds.
5. Supplies: Provide general categories of needed supplies, the method of acquisition, and the estimated cost.
6. Travel: Describe the purpose of the proposed travel in relation to the contract and provide the basis of estimate, including information on destination, number of trips, and number of travelers where known.
7. Other Direct Costs: Enter the total of direct costs not covered by 1 through 6. Attach an itemized list explaining the need for each item and the basis for the estimate.
8. Facilities and Administration (F&A) Costs: Identify F&A cost rate(s) and base(s) as approved by the cognizant Federal agency, including the effective period of the rate. Provide the name, address, and telephone number of the Federal agency official having cognizance. If unapproved rates are used, explain why, and include the computational basis for the indirect expense pool and corresponding allocation base for each rate.
9. Other Indirects: Enter the total of indirect costs not covered by 8. Attach an itemized list explaining the need for each item.
10. Subtotal: Enter the sum of items 1 through 9.
11. Cost Sharing: Enter any amount proposed. If cost sharing is based on specific cost items, identify each item and amount in an attachment.
12. Total: Enter the total after subtracting item 11 from item 10.

E/PO Template #2
Subcontract Budgets
(Costs in Real Year Dollars, Totals in Real Year and FY 2006 Dollars)

	Subcontract #1	Subcontract #2	Subcontract #n
Personnel			
Consultants			
Equipment			
Supplies			
Travel			
Other Direct Costs			
Facilities			
Administration			
Other Indirects			
Subtotal			
Cost Sharing			
TOTAL (Real Yr.)			
TOTAL (FY)			

INSTRUCTIONS FOR E/PO BUDGET SUMMARY – TEMPLATE #2

Provide, as attachments, detailed computations of all estimates in each cost category with narratives as required to fully explain each proposed cost as follows.

1. Personnel: Attachments must list the number and titles of personnel, amounts of time to be devoted to the project, and rates of pay including salaries, wages, and fringe benefits.
2. Consultants: Identify consultants to be used, why they are necessary, the time (number of days) they will spend on the project, and quoted daily rates of pay. State whether the consultant has been compensated at the quoted rate for similar services performed in connection with Government contracts.
3. Equipment: List separately. Explain the need for items costing more than \$5,000. Describe basis for estimated cost. General purpose equipment is not allowable as a direct cost unless specifically approved by the NASA Contracting Officer. Any equipment purchase requested to be made as a direct charge under this award must include the equipment description, how it will be used in the conduct of the work proposed and why it cannot be purchased with indirect funds.
4. Supplies: Provide general categories of needed supplies, the method of acquisition, and the estimated cost.
5. Travel: Describe the purpose of the proposed travel in relation to the project and provide the basis of estimate, including information on destination, number of trips, and number of travelers where known.
6. Other Direct Costs: Enter the total of direct costs not covered by 1 through 5. Attach an itemized list explaining the need for each item and the basis for the estimate.
7. Facilities and Administration (F&A) Costs: Identify F&A cost rate(s) and base(s) as approved by the cognizant Federal agency, including the effective period of the rate. Provide the name, address, and telephone number of the Federal agency official having cognizance. If unapproved rates are used, explain why, and include the computational basis for the indirect expense pool and corresponding allocation base for each rate.
8. Other Indirects: Enter the total of indirect costs not covered by 7. Attach an itemized list explaining the need for each item.
9. Subtotal: Enter the sum of items 1 through 8.
10. Cost Sharing: Enter any amount proposed. If cost sharing is based on specific cost items, identify each item and amount in an attachment.
11. Total Estimated Costs: Enter the total after subtracting item 10 from item 9.

E/PO Template #3

Key Personnel

(Percent Time Committed/Direct Costs, Including Benefits,
in Real Year Dollars, Totals in Real Year and FY 2006 Dollars)

	FY1	FY2	FY3	FYn	Total (Real Yr.)	Total (FY 2006)
Institution 1						
PI (% time)						
PI (direct cost)						
E/PO lead (% time)						
E/PO (direct cost)						
Institution 2						
PI (% time)						
PI (direct cost)						
E/PO lead (% time)						
E/PO (direct cost)						
Institution n						
PI (% time)						
PI (direct cost)						
E/PO lead (% time)						
E/PO (direct cost)						

INSTRUCTIONS FOR E/PO BUDGET SUMMARY – TEMPLATE #3

Workforce staffing plan for key personnel must be phased by fiscal year. In tabular form, the Workforce Table for Key Personnel must give the names and intended work commitment for the mission PI and key E/PO personnel of the proposed project both in time (rounded to the nearest 0.01 of a Work Year typically of 1880 hours) and salary (without addition of overhead or fees - rounded to the nearest \$1K) for each year of the proposed period of performance.

K. APPENDICES

The following additional information is required with the CSR. This information can be included as Appendices to the CSR, and, as such, will not be counted within the specified page limit.

1. Letters of Commitment. Letters of Commitment, updated for the CSR, must be provided from:
 - Any U.S. organization, including other Government agencies, or non-U.S. organization that is offering to contribute critical facilities (e.g., ground or space network(s), integration and test, thermal vacuum chambers, L-Tool, etc.), goods, hardware, software, and/or services.
 - Any U.S. organization, including other Government agencies, or non-U.S. organization that is offering to contribute the time and/or services of Co-Investigators, including E/PO participants. The letter must include the amount of the contribution in terms of approximate number of Full Time Equivalent (FTE) work years over the nominal duration of the proposed project (i.e., through Phase E) and the signature of an authorizing official of the individual's organization. In addition, the dollar value of the contribution must be included in the Total Mission Cost.
 - Any prime contractor, major subcontractor, or other participant that is named in the proposal and will provide critical hardware, facilities, goods, or services, whether contributed or not. The letter must include an acknowledgement of the work to be performed, a commitment to perform the work as proposed and for the cost proposed, and the signature of an authorizing official of the organization. The dollar value of the contract or subcontract that is expected to be funded through NASA if the proposal is selected must be included in the MEP Cost.
 - NASA or Government providers for services and/or facilities offered in the AO for which resources are limited. This includes the JPL Interplanetary Network Directorate [for the DSN and the Advanced Multimission Operations System (AMMOS)] and others as applicable. The letter must include an acknowledgement of both the quantity and timing of resources required for the proposed effort, as well as the estimated cost of these resources and the signature of an authorizing official of the organization. The cost of the services and/or facilities must be included in the MEP Cost.
2. Subcontracting Plan. A preliminary subcontracting plan, outlining the proposed investigation's approach to small and small disadvantaged business subcontracting as described in Appendix A, Section XIII, of the AO, must be provided. This plan will be negotiated prior to exercising the Phase B contract option.
3. Relevant Experience and Past Performance. Proposals must include a discussion of *relevant* experience and past performance by the major team partners in meeting the requirements of projects *similar* to the subject of the CSR. This can include airborne or space-based instrument development and investigations. For this part of the CSR, NASA is seeking information *about the partner organizations* rather than individuals. Projects that ended more than 5 years ago

need not be included in the discussion. The discussion of relevant experience and past performance must include a description of each project; its relevance to the subject of the CSR; the proposed performance and the actual performance; the planned delivery schedule of data to the PDS and the actual delivery schedule of data to the PDS, the proposed cost and actual cost; the proposed schedule and actual schedule; an explanation of any differences between proposed performance, cost and schedule and what was actually achieved; and points of contact for the past project's customer. If the customer for the past project was the United States government, then the contract number must be included along with current technical point(s) of contact and phone number(s). For projects that are not yet complete, the current projected performance, cost, and schedule must be used in place of actual values.

In evaluating the CSR, NASA will consider the past performance of the major partner organizations. The evaluation of past performance will not be arithmetic; instead, the information deemed to be most relevant and significant will receive the greatest consideration. Relevant experience will be viewed as the demonstrated accomplishment of work, which is comparable or related to the objectives of the CSR. This includes airborne or space-based instrument development and investigations and associated development processes including engineering processes, management processes, operations, data analysis and delivery of data to the PDS or other appropriate data archives. NASA will review the past performance information provided by the proposer. In addition, NASA may review, the major team partners past performance on other NASA and/or non-NASA projects or contracts that provide insight into those institutions past performance on airborne or space-based instrument development and investigations and associated development processes including engineering processes, management process, operations, data analysis and delivery of data to the PDS or other appropriate data archives. In conducting the evaluation, NASA reserves the right to use *all* information available.

The investigation team is cautioned that omissions or an inaccurate or inadequate response to this evaluation item will have a negative effect on the overall evaluation, and while NASA may consider data from other sources, the burden of providing relevant references that NASA can readily contact rests with the investigation team.

4. Resumes. Provide resumes for all key personnel identified in the Management section. Also provide resumes for key E/PO lead personnel. Include resume data on experience that relates to the job these personnel will be doing for the proposed investigation.
5. Statements of Work for each Contract Option. Provide draft Statement(s) of Work for all potential contracts with NASA. These Statement(s) of Work should (as a minimum) be for each contract option (i.e., 3 month Bridge Phase, remainder of Risk-Reduction Phase, Phase B, Phase C/D, and Phase E) and clearly define all proposed deliverables (including science data) for each option, potential requirements for Government facilities and/or Government services, and a proposed schedule for each option and the entire mission.

6. Level 1 Requirements. This appendix should provide a formal definition of the science requirements. In addition, it may be used to summarize and capture draft programmatic requirements and mission success criteria. Examples are provided in the Mars Scout Library.
7. RHUs and/or Radioactive Material Sources for Instruments Plan (as applicable). This usage will require additional environmental review documentation consistent with NASA policy and procedures (14 CFR Part 1216, Subpart 1216.3), the National Environmental Policy Act of 1969, as amended (NEPA) (42 U.S.C. 4321 et seq.), and the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 CFR Pars 1500-1508). These documents are also listed in the Mars Scout Library. Missions that use RHUs will also be required to complete a separate administrative process for nuclear safety launch approval (Presidential Directive/National Security Council Memorandum No. 25). Use of one or more RHUs will require preparation of either an Environmental Assessment or an Environmental Impact Statement (EIS) to satisfy the NEPA requirements and completion of a detailed and rigorous nuclear safety launch approval process. Provide a detailed plan and schedule that outlines the approach for implementing these requirements.
8. Planetary Protection Approach. Early in the Phase A Concept Study, investigation teams are encouraged to work with NASA's Planetary Protection Officer to verify/determine the appropriate planetary protection category and any special considerations and/or study requirements that may exist. Provide an approach to planetary protection consistent with *NPR 8020.12C, Planetary Protection Provisions for Robotic Extraterrestrial Missions*, available through the Mars Scout Library. Outline any special requirements on personnel, instrumentation, spacecraft assembly, facilities, launch configuration, or mission operations. Obtain a planetary protection certification for the mission (if required) in accordance with *NPD 8020.7F, Biological Contamination Control for Outbound and Inbound Planetary Spacecraft*, and *NPR 8020.12C*. For clarification of planetary protection requirements, contact the Planetary Protection Officer, Dr. Catherine Conley at 202-358-3912 or Cassie.Conley@nasa.gov.
9. Incentive Plan(s). Draft Incentive Plans (if applicable) should be included with the Concept Study. Incentive Plans should outline contractual incentive features for all major team members. Incentive Plans should include both performance and cost incentives, as appropriate.
10. Compliance with Procurement Requirements by NASA PI (if applicable). The same guidelines as in AO Appendix B apply.
11. Technical Content of Any International Agreement(s). Draft language for the technical content of any International Agreement(s) are required for all non-U.S. partners in the investigation. A sample agreement is available in the Mars Scout Library. The draft language must include (i) a brief summary of the mission and the foreign partner's role in it, (ii) a list of NASA's responsibilities within the

partnership, and (iii) a list of the non-U.S. partner's responsibilities in within the partnership. Note that NASA prefers to establish agreements with government funding agencies, not with the institution which will be funded to perform the work.

12. Discussion on Compliance with U.S. Export Laws and Regulations. Provide an update to the discussion in the proposal. Investigations that include international participation, either through involvement of non-U.S. nationals and/or involvement of non-U.S. entities must include a section discussing compliance with U.S. export laws and regulations; e.g., 22 CFR 120-130, *et seq.* and 15 CFR 730-774, *et seq.*, as applicable to the scenario surrounding the particular international participation. The discussion must describe in detail the proposed international participation and is to include, but not be limited to, whether or not the international participation may require the proposer to obtain the prior approval of the Department of State or the Department of Commerce via a technical assistance agreement or an export license, or whether a license exemption/exception may apply. If prior approvals via licenses are necessary, discuss whether the license has been applied for or if not, the projected timing of the application and any implications for the schedule. Information regarding U.S. export regulations is available through Internet URLs <http://www.pmdtc.org> and <http://www.bis.doc.gov>. Proposers are advised that under U.S. law and regulation, spacecraft and their specifically designed, modified or configured systems, components, parts, etc., such as the instrumentation being sought under this AO, are generally considered “Defense Articles” on the United States Munitions List and subject to the provisions of the International Traffic in Arms Regulations, 22 CFR 120-130, *et seq.*
13. Communications Link Budget Design Data. Include communications block diagram and link budget design control tables for all radio communications links (data and carrier) showing relevant spacecraft and earth station parameters and assumptions for the highest data rate and the emergency link at the maximum distance and throughput at which each particular link could be used. Particularly, provide losses, loop bandwidths, coding, antenna gains, and such other parameters identified in the document *NASA’s Mission Operations and Communication Services*, in the Mars Scout Library.
14. Cost and Pricing for Risk-Reduction Phase Contract. To assure that the deliverables via the CSR facilitate a direct and easily implementable risk-Reduction Phase contract, proposers must provide cost and pricing data for Risk-Reduction Phase which meet the requirements of the FAR Part 15 Table 15-2 (see the Mars Scout Library section on Directives and Procurement-related Information). This Risk-Reduction Phase cost and pricing data is necessary and required to implement the contract. This data is ***in addition*** to the data provided in Cost Figures 1-6 for evaluation purposes, allocates project costs per the cost categories defined in Table 15-2, but still align at the highest levels with the evaluation data. Also see Section J of Part II above for additional guidance.
15. Additional Cost Data to Assist Validation. In addition to the specific cost table data requested in the Cost Proposal, Section J, proposers should also provide any

additional costing information/data which they feel will assist NASA to validate the project's proposed costs. Vendor quotes, cost estimates, rationale for design heritage cost savings, are all examples of data that can be included here. However, in specific, all costs to the lowest level of the proposer's WBS should be provided in Microsoft Excel format.

16. Science Change Matrix. Should the Phase A effort result in any science change (including a science implementation change) from that originally proposed, provide the new requirement, the old requirement, the rationale for the change, and the section/paragraph where the change occurs in the CSR.
17. Data Management Plan Approach. Although no Project Data Management Plan is required for delivery via the Concept Study, this plan will be required at PDR. In the CSR, however, proposers must discuss all plans (schedules, costs, and deliverables) and their approach and commitment to delivering project data to the appropriate NASA data archives and indicate such in the plans and schedules for Phase B. In addition, this discussion must provide assurance that that all activities have been considered and included with appropriate resources separately allocated and budgeted.
18. Sample Curation Plan (if appropriate). Discuss the plans for all aspects of curation of the samples. The Sample Curation Plan should describe the process and schedule for preparation of the curatorial facility, planned physical security, documentation, inventory process, environmental preservation measures, plans for distribution of the samples, preliminary examination of the samples, contamination control procedures, curation laboratory requirements, any modifications needed to the Astromaterials Curation Facility. Also, describe how a curatorial representative will work with the PI in planning the sample curation. Discuss all aspects of curation from planning through distribution and storage. Funding for use of the JSC Curatorial Facility, including all required laboratory construction or modification, must be included in the budget for the proposed mission. The actual costs for all aspects of curation from planning through distribution and storage will be borne by the mission from inception to two years following sample return. See Section 6.2.2 of the AO on Protocols and Policies for Handling Returned Samples and the Mars Scout Library for guidance on documentation, reviews and costs.
19. Project Plan Approach. Although the Project Plan is not required for delivery as part of the CSR, the CSR should indicate the approach to complete this activity since the Preliminary Project Plan is due at the end of the Risk-Reduction Phase. The Baseline Project Plan, written according to NPR 7120.5D, is a required product for KDP C.
20. Orbital Debris Analysis. No orbital debris analysis is required with the CSR, however, this analysis will be required for PDR and CDR per NPD 8710.3B, NASA Policy for Limiting Orbital Debris Generation. This document can be found in the Mars Scout Library.

21. References List (optional). The Phase A CSR may provide, as an appendix, a list of reference documents and materials used in the Concept Study. The documents and materials themselves cannot be submitted, except as a part of the Concept Study.
22. Abbreviations/Acronyms List. To aid in the evaluation process, every abbreviation and acronym used in the CSR should be included in this table even if it has been defined at first usage in the Report.
23. Independent Technical Authority. Discuss the plans for meeting the requirements of Section 3.4 of NPR 7120.5D. For institutions that are not NASA centers, the senior authorizing official for the institution is responsible for fulfilling or delegating the role assigned to the Center Director in Chapter 3 of NPR 7120.5D. This role includes assigning a senior systems engineer that is funded by that institution's engineering organization who reports technical issues to the Program Chief Engineer. This role also includes assigning a Safety and Mission Assurance (SMA) lead that is funded by that institution's SMA organization who reports SMA issues to the Program SMA lead.
24. Heritage.

Describe heritage for each instrument, each spacecraft subsystem, each ground system, and each major module of flight or ground software. The description should address:

- The design basis:
 - Describe the closest heritage system, including recent application(s), dates of use, developer institution, and cost.
 - Is the developer (institution) on the proposing team?
 - Will the individuals who participated in the heritage basis be available to the proposing team?
 - State whether spaceflight-proven, ground or aircraft application, or other status.
 - Indicate the highest assembly level at which full heritage is claimed.
- Difference between the basis and the proposed design:
 - Describe differences in the environment and/or application.
 - Why is the design modification required?
 - Specify exactly what will be modified.
 - Characterize the difference in relevant terms: mass reduction, reduced power draw, cost saved, etc.
- Development challenges:
 - Describe any circumstances that might adversely impact the proposer's ability to achieve the planned design heritage or to deliver the new technology item.
 - Describe the steps planned to ensure that claimed design heritage is captured.
 - Describe remedial action plan should the expected design prove undeliverable within resources.

Provide substantiation of all heritage claims including descriptions of changes required to accommodate project-unique applications and needs. Where enhancements to heritage elements are proposed or heritage is from a different application, sufficient descriptions should be provided to independently assess the current level of maturity. Generally, systems with significant levels of claimed heritage are expected to provide sufficient mass details to allow independent validation. For systems with minimal or partial heritage, provide sufficient explanation to validate readiness of: a) proposed enhancements/modifications, and b) the maturation plan. The maturation plan should include: a) decision criteria for determining if technology efforts should be ended, and b) backup options. This description of heritage will be used by the evaluation team to assign levels of heritage for the applicable seven areas in the following table. The evaluation team will use a scale with at least three levels (full, partial, or none) as illustrated in the table below.

	Full heritage	Partial heritage	No heritage
Design	Identical	Minimal modifications	Major modifications
Manufacture	Identical	Limited update of parts and processes necessary	Many updates of parts or processes necessary
Software	Identical	Identical functionality with limited update of software modules (<50%)	Major modifications (>=50%)
Provider	Identical provider and development team	Different however with substantial involvement of original team	Different and minimal or no involvement of original team
Use	Identical	Same interfaces and similar use within a novel overall context	Significantly different from original
Operating Environment	Identical	Within margins of original	Significantly different from original
Referenced Mission	In operation	Built and successfully ground tested	Not yet successfully ground tested